This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 2^2 + 1 \div 20 * 19 \div 5$$

The solution is 0.190, which is option A.

A. $[0.18, 0.27]$

* 0.190, this is the correct option

B. $[-0.03, 0.13]$

0.001, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[7.96, 8.06]$

8.001, which corresponds to two Order of Operations errors.

D. $[8.17, 8.23]$

8.190, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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2. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-2178}{11}}i + \sqrt{165}i$$

The solution is Nonreal Complex, which is option A.

A. Nonreal Complex

* This is the correct option!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 + 88i}{4 - 3i}$$

The solution is $-0.48 + 21.64i$, which is option B.

A. $a \in [15.5, 18.5]$ and $b \in [-29.5, -28.5]$

$15.75 - 29.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-1, 0]$ and $b \in [20.5, 23]$

* $-0.48 + 21.64i$, which is the correct option.

C. $a \in [-13, -10]$ and $b \in [20.5, 23]$

$-12.00 + 21.64i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [19.5, 21.5]$ and $b \in [6, 7]$

$20.64 + 6.52i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-1, 0]$ and $b \in [540.5, 542.5]$

$-0.48 + 541.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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4. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{53361}{441}}$$

The solution is Whole, which is option B.

A. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

B. Whole

* This is the correct option!

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 231.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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5. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 19^2 + 13 \div 4 * 15 \div 1$$

The solution is -303.250, which is option A.

A. $[-305.25, -301.25]$

* -303.250, this is the correct option

B. $[368.22, 380.22]$

370.217, which corresponds to two Order of Operations errors.

C. $[416.75, 420.75]$

418.750, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[-360.78, -350.78]$

-351.783, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(2 - 10i)(-8 - 3i)$$

The solution is $-46 + 74i$, which is option E.

A. $a \in [-18, -11]$ and $b \in [27, 31]$

$-16+30i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [11, 15]$ and $b \in [82, 90]$

$14 + 86i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-50, -38]$ and $b \in [-74, -69]$

$-46 - 74i$, which corresponds to adding a minus sign in both terms.

D. $a \in [11, 15]$ and $b \in [-88, -85]$

$14 - 86i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-50, -38]$ and $b \in [73, 76]$

* $-46 + 74i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-8 - 9i)(10 - 4i)$$

The solution is $-116 - 58i$, which is option A.

A. $a \in [-118, -110]$ and $b \in [-60, -52]$

* $-116 - 58i$, which is the correct option.

B. $a \in [-46, -43]$ and $b \in [-123, -115]$

$-44 - 122i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-118, -110]$ and $b \in [52, 60]$

$-116 + 58i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-46, -43]$ and $b \in [115, 125]$

$-44 + 122i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-81, -74]$ and $b \in [34, 39]$

$-80 + 36i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{39204}{484}}$$

The solution is Integer, which is option A.

A. Integer

* This is the correct option!

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

D. Irrational

These cannot be written as a fraction of Integers.

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -198.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-910}{5}}i + \sqrt{156}i$$

The solution is Nonreal Complex, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Nonreal Complex

* This is the correct option!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{72 - 77i}{-6 + 2i}$$

The solution is $-14.65 + 7.95i$, which is option A.

A. $a \in [-15, -14]$ and $b \in [7, 9.5]$

* $-14.65 + 7.95i$, which is the correct option.

B. $a \in [-15, -14]$ and $b \in [316.5, 319]$

$-14.65 + 318.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-12.5, -11.5]$ and $b \in [-39, -38]$

$-12.00 - 38.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-8, -6]$ and $b \in [14.5, 16.5]$

$-6.95 + 15.15i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-587, -585.5]$ and $b \in [7, 9.5]$

$-586.00 + 7.95i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.